

**Before The
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

| | | |
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| _____ |) | |
| In The Matter Of |) | |
| Review of the Spectrum Sharing Plan Among |) | IB Docket No. 02-364 |
| Non-Geostationary Satellite Orbit Mobile |) | |
| Satellite Service Systems in the 1.6/2.4 GHz |) | |
| Bands |) | |

| | | |
|---|---|----------------------|
| Amendment of Part 2 of the Commission's |) | |
| Rules to Allocate Spectrum Below 3 GHz for |) | |
| Mobile and Fixed Services to Support the |) | ET Docket No. 00-258 |
| Introduction of New Advanced Wireless |) | |
| Services, Including Third Generation Wireless |) | |
| Systems |) | |

To: The Commission

REPLY COMMENTS OF QUALCOMM INCORPORATED

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SUMMARY

QUALCOMM is the developer of the airborne terminals currently in service using the Globalstar satellite communications system and is pleased to submit these reply comments to provide the Commission with additional information concerning the restrictions imposed on Globalstar aviation service as a result of the need to meet stringent Radio Astronomy and GNSS protection requirements. In the Further Notice of Proposed Rule Making (“FNPRM”) in this proceeding, the Commission noted that it did not have sufficient information about these restrictions and whether these restrictions deter the sharing of additional spectrum in the L Band. See FNPRM at para. 98.

QUALCOMM participated in the RTCA Special Committee 165 in the development of the document DO-262 and is therefore qualified to explain the applicability of this document and the requirements which dictate the restrictions imposed on the Globalstar aviation service to frequency bands above 1616 MHz. These restrictions do in fact deter the sharing of additional spectrum in the L Band for reasons explained herein. In reviewing the comments filed in this proceeding, it is clear that further clarification is necessary because the frequency restriction is not a result of failure to meet OOB emission requirements, but a need for Globalstar AES to comply with existing frequency selectivity specifications for airborne GNSS systems.

In these reply comments, QUALCOMM provides a detailed technical explanation of the restrictions imposed on Globalstar’s aviation service as a result of DO-262, including an overview of the filtering that has been incorporated in the multi-channel and single-channel products.

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To: The Commission

COMMENTS OF QUALCOMM INCORPORATED

QUALCOMM Incorporated ("QUALCOMM"), by its attorney, hereby submits its Comments in the above-referenced proceeding to provide the Commission with technical information to explain the restrictions imposed on Globalstar in providing aviation services.

I. Background

QUALCOMM is a world leader in developing innovative digital wireless communications products and services based on the Company's patented Code Division Multiple Access (CDMA) digital technology. The Company's business areas include CDMA chipsets and system software; technology licensing; the Binary Runtime Environment for Wireless[™] (BREW[™]) applications platform; Qchat[™] push-to-talk technology; Eudora[®] e-mail software; and satellite-based systems, including portions of the Globalstar[™] system and wireless fleet management systems, OmniTRACS[®] and OmniExpress[®]. QUALCOMM owns patents that are

essential to CDMA wireless telecommunications standards that have been adopted or proposed for adoption by standards-setting bodies worldwide

II. Globalstar Aviation Products

Iridium has contended that “Globalstar could prevent its out of band emissions from interfering in spectrum below 1614 MHz if it employed better filter technology.” Iridium Ex Parte Letter to FCC, dated June 2, 2004, at 1 (quoted in FNPRM at para. 97). In fact, Globalstar’s aviation products do indeed employ state-of-the-art filtering to control out of band emissions (OOB), but as discussed in Section III herein, it is not the OOB emissions limits which are restricting the use of Globalstar’s aircraft earth station (“AES”) terminals to channels above 1616 MHz. Rather, the “Maximum Total Transceiver Output” requirement specified in DO-262 reflects the limitation of current Out-of-Band Continuous Wave (CW) Signal Rejection of airborne GNSS receiver systems, and it is this limitation that dictates that Globalstar’s AES terminals operate only on channels above 1616 MHz.

QUALCOMM has developed a Medium Data-rate SATCOM System (MDSS) with bi-directional data rates up to 128 kbps on-demand. This product uses a single carrier with multiple CDMA channels aggregated and was designed to have a maximum transmitter power of 39 dBm per transmitter at the antenna port, with up to two transmitters per aircraft. The total power at the antenna port can be up to 42 dBm. In order to comply with the RTCA out of band emissions requirements and protection of Radio Astronomy a substantial transmit filter was required (see Figure 1 below).

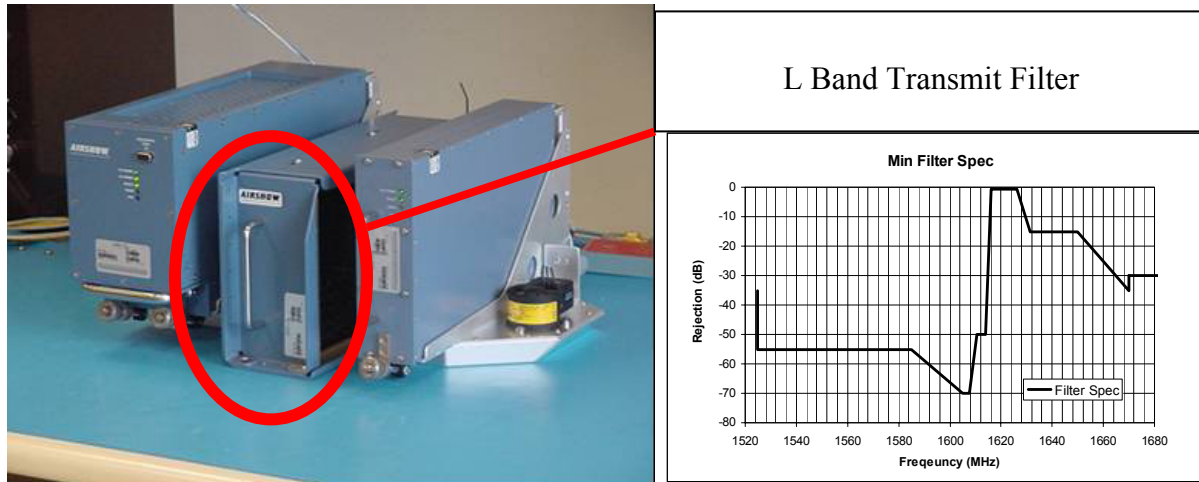
Globalstar Medium Data rate SATCOM System (MDSS) comprises the following

4 MCU tray-mounted Medium Data Rate Terminal (MDT)

2 MCU tray-mounted RF Power Amplifier (RFPA)

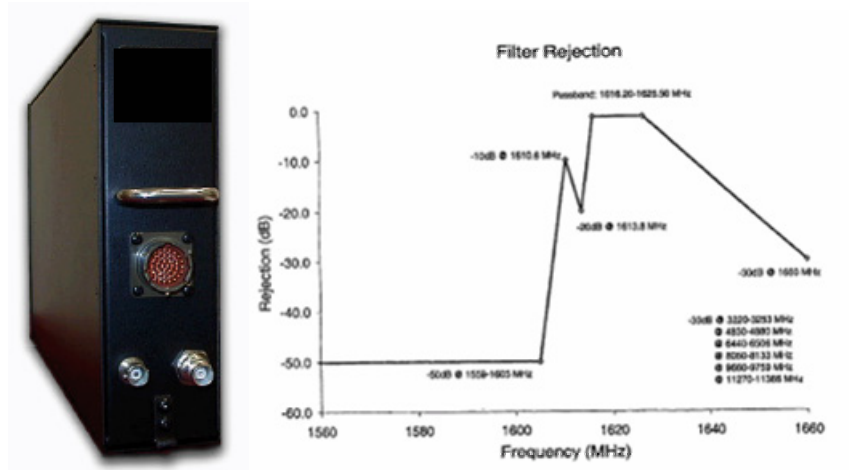
RF Transmit Filter: **max 1.5 dB Insertion loss 1616 to 1626.5 MHz.**

Figure 1.



QUALCOMM has also provided components to avionics manufacturers to produce single-channel airborne products to be used on the Globalstar system. One of the components that is supplied for the single channel product is a transmit filter which is necessary to provide protection for Radio Astronomy and GPS systems installed on board the same aircraft as the Globalstar AES. Figure 2 below shows the single “box” product with an internal transmit filter that meets the rejection characteristics shown in the adjacent plot.

Figure 2



III. RTCA DO-262 Applicability

In Iridium's Comments in this proceeding, Iridium raised a question about the applicability of DO-262 Document given that Globalstar currently provides non-safety services (AMSS) for the aviation industry. Iridium Comments (filed Sept. 8, 2004) at Pg. 14.

QUALCOMM, Globalstar and Iridium participated in the RTCA Special Committee 165, which was commissioned to produce DO-262 (Minimum Operation Performance Standards (MOPS) for the Next Generation Satcom Systems (NGSS)). In the development of this standard, the committee agreed to identify requirements for systems that provide non-safety services and significant time was devoted to identifying the essential compatibility requirements that would apply to a non-safety AES. As a result the following text appears in the RTCA DO-262 document;

Page 1: "Compliance with these standards is recommended as one means of assuring that NGSS avionics will perform its intended function(s) satisfactorily under all conditions normally encountered in routine aeronautical operations. *Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.*"

Page 2 paragraph 7: “ Appendix C is an informative appendix containing specific recommendations tailoring the requirements contained in this MOPS *for equipment that supports only non-safety AMSS communications.*”

Page 15 Definitions: “**Next Generation Satellite System (NGSS):** A satellite communications system that provides AMS(R)S which may be voice, data or both. An NGSS includes AESSs, satellites, GESs and network control system facilities that perform administrative and operational management functions. *An NGSS may provide non-AMS(R)S communications.*”

Appendix C – “RECOMMENDED STANDARDS FOR AMSS EQUIPMENT NOT PROVIDING AMS(R)S SAFETY SERVICES

This appendix provides guidance on the tailoring of the MOPS requirements for AMSS equipment that does not provide AMS(R)S.....Manufacturers of non-safety AMSS equipment using NGSS technologies are urged to consider all of the antenna (Section 2.2.2.1), transmitter (Section 2.2.2.1.1) and receiver (Section 2.2.2.1.2) requirements as guidance in their design.”

In order to comply with the minimum requirements of the RTCA DO-262 document, QUALCOMM and Globalstar, as an NGSS system applicant, submitted information regarding the technical characteristics of the Globalstar NGSS. The technology-specific technical requirements for the Globalstar system were reviewed by the SC-165 committee and this attachment was published by QUALCOMM in 2001.

The QUALCOMM-developed Medium Data Rate Satcom System (MDSS) described in section II has been certified by the FAA using the Supplemental Type Certification (STC) process. The MDSS has been certified on a general aviation aircraft (STC No. ST01064WI) and more recently on a commercial aircraft operated by a major US carrier (STC No. ST10147SC-

D). In both cases, the FAA reviewed a data package, which included reports from tests performed and witnessed in accordance with RTCA DO-262 and the Globalstar Technology Specific Attachment.

Thus, it would not be appropriate for the FCC to disregard the requirements imposed on Globalstar's aviation products as a result of RTCA DO-262. The FAA, in approving these products, relied on QUALCOMM's compliance with RTCA DO-262.

IV. Technical Explanation for Frequency Restriction above 1616MHz

This section addresses the interference issues between the aviation Global Positioning (GPS) System and the Globalstar Aircraft Earth Stations.

The Globalstar AES is designed to have a maximum transmitter power of 39 dBm per transmitter at the antenna port and up to two transmitters per system. The total power at the antenna port is 42 dBm. Because the Globalstar transmit frequency allocation is 1610 MHz to 1621.35 MHz means that the Globalstar AES is a potential interferer to the GPS system (1575.42 MHz) installed on the same aircraft. This section discusses the limitation of current Out-of-Band Continuous Wave (CW) Signal Rejection of GPS sensors/receivers.

The interference between the Globalstar AES and GPS depends on the isolation between two systems.

RTCA DO-262 contains a section "**2.2.3.1.2.1.3 Maximum Total Transceiver Output**" which specifies the total average power output of the transceiver and specifies that the power shall not exceed the values given in Table 2-2 shown below.

Table 2-2 Maximum Carrier Output Level

| Minimum Carrier Frequency (MHz) | Maximum Carrier Frequency (MHz) | Transmitter Power in 1 kHz Band |
|---------------------------------|---------------------------------|---|
| 1315 | 1525 | $-0.179 \times (f - 1315) + 29.5 \text{ dBW}$ |
| 1525 | 1565 | $-2.65 \times (f - 1525) - 8 \text{ dBW}$ |
| 1565 | 1585 | -116.5 dBW |
| 1585 | 1605 | -115.0 dBW |
| 1605 | 1614 | $7.67 \times (f - 1605) - 115 \text{ dBW}$ |
| 1614 | 1626.5 | $4.64 \times (f - 1614) - 46 \text{ dBW}$ |
| 1626.5 | 2000 | $0.036 \times (f - 1626.5) + 12 \text{ dBW}$ |
| 2000 | above | 25.5 dBW |

The levels shown in table 2.2 were derived from the GNSS sensor/receiver selectivity specifications and assume a 40 dB isolation between the GNSS antenna and the AMSS or AMS(R)S antenna. The following note appears in DO-262 to explain the derivation of this limit and the isolation assumption.

Note 1: This requirement is included to provide compatibility with the GNSS receiver susceptibility requirements. The linear segments were determined from Appendix B of the GNSS SARPS. The absolute power levels are given at the input to the AMSS/AMS(R)S antenna. The absolute power levels assume a minimum isolation between the GNSS antenna output to the GNSS receiver and the AMS(R)S antenna input of 40 dB. This value is consistent with the assumptions made in DO-210D and the Chapter 4 SARPs.

It is as a result of this maximum transmitter power limitation that the Globalstar AES can only operate at the high frequency end of the MSS band, 1616.26 MHz to 1621.35MHz. At the low frequency end of the MSS band, for example at 1610 MHz, the transmitter power is restricted below 10 dBm (not including GLONASS requirement). Such low power basically prohibits the operation of Globalstar AES. The specification severely limits the Globalstar

aviation service frequency planning and deployment. It also greatly reduces the total data/voice traffic that Globalstar AES systems are capable of providing to and from the aircraft.

In the Globalstar technique specific attachment to DO-262, there is a modification to this section which specifies that Globalstar AES must not be used on board an aircraft which has a GLONASS system because compatible operation would require a significant amount of additional isolation beyond the assumed minimum of 40dB. The technique specific attachment also contains a modified Table 2-2 to reflect the out of band selectivity requirements for GPS only systems (i.e. no GLONASS requirements). Compliance with the GPS requirement is achievable at the higher frequencies (>1616MHz) with additional isolation.

The usable L band channels increase as the isolation increases. This is the method currently in use, but the method is very limited by the size of airplanes. The installation and deployment must be evaluated on a case by case basis. The isolation increases 6 dB theoretically as the antenna physical separation doubles in free space. A minimum of 30 dB increase of the isolation needed at 1610 MHz would require increasing the antenna physical separation $2^5 = 32$ times, comparing 105 inches needed for a standard 40 dB isolation with this multiplier results in an unattainable situation as aircraft length is limited.

In accordance with DO-262 the manufacturer may establish a system-specific requirement different from the assumed 40 dB. Such a requirement shall be declared in the system-specific attachment. When an isolation value different from 40 dB is declared in the system specific attachment, the allowable power output values in Table 2-2 may be changed by an equivalent amount.

The Globalstar Technique specific attachment allow for the limits to be adjusted if the actual GPS antenna and receiver type is known for a particular installation and provides isolation due to integrated filter performance.

From the graphs (Figure 3 and 4) shown below, it is clear that additional isolation (beyond the assumed 40dB) is required even at 1616 MHz before an AES such as the 9dBW Max Power single MDSS system can be demonstrated to comply with the requirements for GPS. To date this additional isolation (up to 15dB) has been achieved through physical isolation combined with higher quality aircraft GPS antenna's with integrated bandpass filters.

This requirement also places a restriction on the lower power single channel AES products which have a transmit power of 2dBW. An additional isolation of up to 6dB needs to be demonstrated for operation at channel 6 and above.

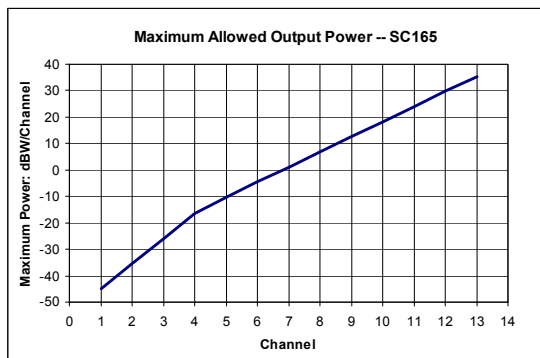


Figure 3

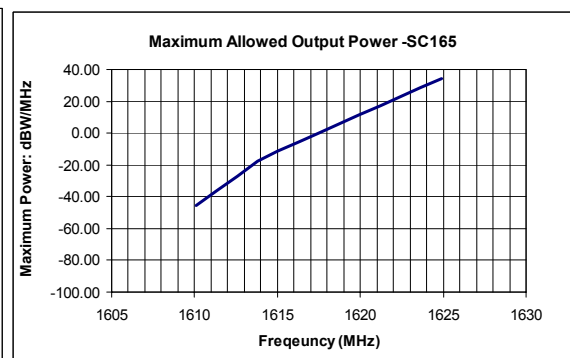


Figure 4

V. Conclusion

QUALCOMM is pleased to provide clarification on the applicability of the RTCA DO-262 specifications and the technical restrictions that this specification imposes on the Globalstar aviation service. QUALCOMM has developed innovative, important aviation products for use on the Globalstar system. However, because the specifications for airborne GNSS

sensors/receivers in DO-262 are less than ideal, Globalstar is effectively restricted to the upper frequency bands of the MSS allocation, i.e., above 1616 MHz.

QUALCOMM has made significant investments in research and development of Globalstar airborne terminals and the cost of such terminals have increased significantly due to the need for compliance with DO-262. The higher power airborne terminals are necessary in order to support the increased voice and data capacity needs of the aviation industry. If Globalstar is to meet the aircraft capacity needs of this industry, then multiple carriers would also be required.

Unless there is a change to the GNSS specifications and a desire by the airlines and general aviation customers to retrofit their aircraft (legacy equipment) with higher quality GPS sensors/receivers (integrated filters) then Globalstar has no choice but to operate at the higher frequency channels for both the single channel and multi-channel AES products.

Respectfully submitted,

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